

**JOINT  
NON-LETHAL WEAPONS  
PROGRAM**

**1998 A YEAR OF PROGRESS**

January 1999

*“I will...direct the Office of the Secretary of Defense to accelerate efforts to field non-chemical, non-lethal alternatives to Riot Control Agents for use in situations where combatants and noncombatants are intermingled.”*

President Clinton

June 23, 1994

Letter to the Senate Transmitting the Chemical Weapons Convention for Ratification

*“Our experience in Somalia with non-lethal weapons offered ample testimony to the tremendous flexibility they offer to warriors in the field of battle. Their use better enables us to respond proportionately and with greater flexibility to the wide range of threats we can expect to face today and in the future.”*

General Charles Krulak

Commandant

US Marine Corps

*“We need to provide our soldiers an alternative to deadly force....Non-lethal weapons provide this alternative while retaining the capability to protect our soldiers and non-combatants in complex and potentially volatile situations.”*

General Dennis Reimer

US Army Chief of Staff

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## **FOREWORD**

Non-lethal weapons in the inventory today provide an enhanced capability to more effectively deal with the ever-increasing challenges across the spectrum of conflict. The recent past indicates the increasing need for non-lethal capabilities for our warfighters. It is imperative to provide troops, both today and in the future, with a full range of options, both lethal and complementary non-lethal, in order to broaden the set of responses available to the political and military strategists and tactical commanders.



With the end of the cold war, multilateral operations to help contain or reduce violence and suffering are occurring with increasing frequency. These operations will, in all likelihood, be the norm for future operations throughout the world. The presence of non-combatants and civilians in these situations is inevitable. For this reason alone, the United States must have the capability to deal with these challenging missions with non-lethal means.

1998 has been a year of notable progress in the non-lethal community. Seven joint operational requirements documents have been signed, each resulting in a new acquisition program funded by the Joint Non-Lethal Weapons Directorate (JNLWD). There are new non-lethal capabilities about to be fielded in the near-term, concepts and requirements have been further defined, and there has been significant research, development, testing and evaluation conducted this year.

In the emerging uncertain and chaotic world of today and in the future, our young men and women in harm's way must be able to respond quickly to crises as diverse as humanitarian assistance or as broad as a major regional conflict. The Joint Non-Lethal Weapons Program will continue to aggressively pursue those technologies and concepts that will provide the best capabilities for our warfighters.

M. R. STEELE  
Lieutenant General, U.S. Marine Corps  
Chairman, NLW Integrated Product Team



# I. INTRODUCTION

## WHERE WE CAME FROM

As the lone remaining superpower, the United States is often called upon to respond to crises around the world. Many of these contingencies are related to humanitarian or peace operations that often must be performed in a violent environment. In recent years the world has seen the fall of the Warsaw Pact, dissolution of the Soviet Union, and the end of the Cold War. These events have led to the withdrawal of our forward-based forces and decreased defense spending while at the same time our armed forces play an increasing role in supporting national policy. Our armed forces therefore must be even more vigilant and ready to deploy when they are called on. Although the overall picture of world security has changed, the need for well trained, well equipped, and well led units in our military has never been more important. We must be ready to respond instantly in these times of uncertainty.

The shift in the world's political/military environment has changed our national security focus from superpowers and détente to the continuously present threat of terrorism, small scale contingencies (SSC), and operations other than war (OOTW). Policy decision makers and military commanders must now work in chaotic situations that may be comprised of numerous small crises that can range from natural disasters to ethnic unrest and civil war. Population trends continue to indicate that littoral urbanization is increasing in the third world. Military operations in urban terrain (MOUT) will undoubtedly be a part of future contingency operations and will include operations among a mix of noncombatants and combatants. Unclear situations such as these will define the beginning of the 21<sup>st</sup> Century.

Non-lethal weapons are now developed to a point that they are a viable option for policy/decision makers and tactical commanders to employ in the environments described above. Deployments to Somalia, Haiti and Bosnia, which are probably similar to the environments our armed forces will confront in the future, confirmed the operational need for non-lethal weapons (NLW). These deployments proved the original concept of non-lethal employment to be correct: NLWs can critically supplement and augment lethal force in the battlespace of the future.

These operational environments were not envisioned just a few years ago, and overwhelming firepower and lethal force are no longer appropriate solutions in certain situations. Commanders must now be sensitive to such factors as the nature of their mission, urban battlespaces, non-state actors, etc., while dealing with such issues as noncombatants and collateral damage. Moreover, leaders at the squad and platoon level will be expected to accomplish their missions in uncertain and dangerous situations.

Military organizations today are deployed around the world using the same tactics, techniques, and procedures as have been used for decades, and joint forces possess a formidable ability to deal with adversaries in a lethal environment. With the introduction of non-lethal weapons, our forces are provided with even greater flexibility and more and better options. NLWs are designed to minimize casualties among combatants and noncombatants and to limit property damage. NLWs today and increasingly in the future will provide on-scene commanders

with new options across the spectrum of conflict, augmenting the lethal means that may need to be applied in the “Three-Block War.”<sup>1</sup>

Non-lethal technologies introduce a new dynamic to the future battlespace. NLWs allow units to accomplish their mission successfully by applying military force consistent with or proportional to the threat. NLWs are new tools in the commander’s arsenal to help contain or reduce violence and suffering while maintaining stability. Today’s military will most likely not be preparing for a confrontation with a former Warsaw Pact adversary. More likely our forces will conduct operations in third world countries where political considerations may be paramount.

While applying lethal force in such situations can possibly make an unstable situation worse, non-lethal weapons may actually serve as a calming influence. They can be an important tool in volatile situations where casualties, particularly noncombatant casualties, are unacceptable. For example, a squad handing out food at a distribution point would certainly prefer firing non-lethal crowd dispersal munitions instead of lethal weapons at an angry, violent crowd.

Non-lethal weapons provide decision-makers a new means to resolve difficult political situations. In peacetime operations, for example, significant work to conduct humanitarian assistance could be overshadowed if because of circumstances deadly force must be applied. Organizations hostile to U.S. assistance/intervention could exploit such an event through the media by presenting it as unnecessary violence and damage. Non-lethal technologies provide a means for precluding such deadly confrontations and denying the opportunity to exploit them for propaganda purposes.

## THE PROGRAM OBJECTIVE

The Joint Non-Lethal Weapons Program began in 1997 as a DoD initiative. The Office of the Secretary of Defense, through DoD Directive 3000.3, has designated the Commandant of the Marine Corps as the Executive Agent (EA) for the Non-Lethal Weapons Program. Section 230 of the National Defense Authorization Act of Fiscal Year 1997 (Public Law 104-201) established a program element that would consolidate and streamline the DoD and military service non-lethal weapons technology program. As noted in the statement of managers accompanying the National Defense Authorization Act for FY98 (S. Rept. 105-29), Congress believes it is important that advanced technologies be developed to provide U.S. military forces with greater flexibility to manage, shape, deter, or contain future conflicts, as they are increasingly confronted by unorthodox, non-traditional, and asymmetrical threats. These challenges, and an increase in U.S. response to peace operations, require the DoD to evaluate new technologies and doctrine for the use of force. In particular, Congress believes the Department should focus on developing new and emerging technologies to extend the scope of possible responses and to facilitate the containment of conflict across the operational continuum.

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<sup>1</sup> General C.C. Krulak has used the “Three Block War” analogy to describe how difficult and challenging urban warfare is on the small unit level. In three blocks, a small unit may have to provide humanitarian assistance in one block, peace enforcement in another block, and fight on a third block.

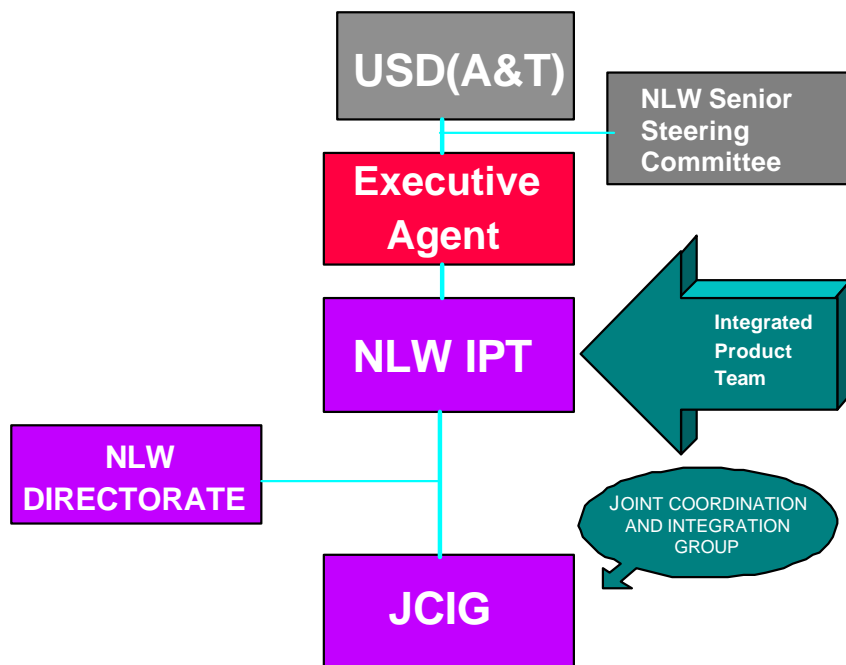


The objective of the JNLWP is to develop, and recommend to the Under Secretary of Defense for Acquisition and Technology (USD A&T), a fully integrated and coordinated NLW program, to provide the most current and accurate information available, and to provide the best NLW technologies and equipment to support our operating forces. The EA is responsible for developing the program, making recommendations, and stimulating and coordinating NLW requirements.

## THE PROGRAM STRUCTURE

The Joint Service Memorandum of Agreement was signed in January 1997 and is currently under revision. In it, the JNLWP is chartered to provide the Joint Chiefs of Staff, the joint services, and other government organizations with recommendations regarding the application of non-lethal technologies to military and law enforcement activities.

The joint service NLW community met in 1998 to continue revising the JNLW Memorandum of Agreement. As a result, it was determined that a streamlining of the organizational structure and the oversight process was necessary. The Joint Coordination and Integration Group has replaced the Joint Concepts and Requirements Group and the Joint Acquisition Group forums by integrating the requirements and acquisition activities into a single advisory group that develops issues for review by the Integrated Product Team. Figure 1 shows the revised organizational structure of the Joint NLW Program.



**Figure 1. Joint NLW Program Revised Organizational Structure**

The organization and responsibilities of each organization are defined in the following paragraphs.

**Executive Agent (EA).** The EA serves as the primary DoD point of contact for NLW. He coordinates between acquisition and requirements communities, expands operational NLW demonstrations within appropriate ACTDs, and provides vision and direction for the DoD NLW Program. The EA ensures the operational utility of all NLW developmental results and facilitates coordination of service testing and evaluation

**Integrated Product Team (IPT).** To accomplish DoD Executive Agent review responsibilities for the Commandant of the Marine Corps, the Marine Corps Deputy Chief of Staff for Plans, Policies and Operations chairs the joint IPT and advises the EA on all joint NLW activities. The Army Deputy Chief of Staff for Operations and Plans serves as vice-chair. The IPT recommends approval of the consolidated DoD NLW Research, Development, Testing, and Evaluation Program Objective Memorandum (RDT&E POM). It provides oversight to review and resolve security, environmental, health and safety, and policy issues that may arise in the development of NLW programs and it is the final arbiter for service concerns.

**Joint Coordination and Integration Group (JCIG).** The principal role of the JCIG is to advise on (and to assist in harmonizing) all facets of NLW system acquisition from concept exploration to production. It is chaired by the Director, Joint Non-Lethal Weapons Directorate and coordinates and integrates JNLWP concepts and requirements into a management system to achieve standardization and interoperability and to optimize resources. The JCIG maintains and updates the DoD *Joint Concept for NLW*; reviews NLW Mission Need Statements and Operational Requirements Documents for joint applicability and recommends joint programs; develops and prioritizes the DoD Requirements List in support of POM development; reviews service NLW programs; recommends approval of new starts or termination of unsuccessful or unrewarding efforts; and coordinates and assists in determining a lead service.

**Joint NLW Directorate (JNLWD).** The JNLWD functions as the EA's action office for managing the day-to-day activities of the JNLWP and supporting the IPT. Their responsibilities include serving as the DoD NLW focal point, performing liaison with the services, joint staff, ACTD program managers, other government agencies, industry, and foreign entities, and sustaining program corporate memory.

## **II. REQUIREMENTS AND PROGRAMS**

### **NLW CORE CAPABILITIES REQUIREMENTS ANALYSIS**

In 1998, the core capability requirements identified in the Joint Concept for NLW (published in January) were used to conduct a critical analysis of capabilities under development. This analysis, conducted by representatives of the Combatant CINCs and others from the NLW community, identified gaps in satisfying the needed capabilities of the core functional areas. The chart below summarizes the findings.

CURRENT CAPABILITY	CROWD CONTROL	INCAPACITATE PERSONNEL	DENY AREA-PERSONNEL	DENY AREA-VEHICLES	DISABLE VEH/AC/FAC/VESSELS	CLEAR FACILITIES PERSONNEL
Green						
Yellow						
Red						

These results were widely used in the management of the JNLWP in 1998. The early acquisition programs that most significantly contributed to the satisfaction of the core capabilities were accelerated where possible. Solicitations for the Technology Investment Program were heavily vested in the results of the above "gap analysis." Additionally, the FY 99 program plan includes other adjustments to funding priorities that directly relate to the outcomes of the analysis.

## THE FUNDED PROGRAMS

In order to fill some of the gaps that have been identified in the fulfillment of the core capability requirements for non-lethal weapons, the Joint NLW Program is funding a number of programs. The substantial progress in 1998 was highlighted with seven signed operational requirements documents and the first formal acquisition milestone decision. Formalizing the early acquisition programs will accelerate the fielding of new NL capabilities in the near-term. The following paragraphs summarize current JNLWP development efforts.

## ACQUISITION PROGRAMS



### MODULAR CROWD CONTROL MUNITION (MCCM)

This effort creates a non-lethal variant of the Claymore mine. The lethal fragmentary payload is replaced with numerous rubber ball blunt impact munitions for use in crowd control. Since its inception, the non-lethal MCCM has been intended for use as both a ground and vehicle-mounted munition. In order to meet an aggressive program schedule and work within the funding requested, most of the development has been focused on the munition. FY97 funding was used to prepare the initial program documentation, design prototype test hardware, and perform initial testing. FY98 program funding was used to complete the design of the munition based on the results of the prototype tests. The design, fabrication, and proof-of-principle testing of an MCCM vehicle mount and protection bracket was also completed. The bracket design will ensure no potential for injury to the vehicle occupants exists when the device is fired. Milestone III (Production Decision for the munition only) is planned for FY99. Procurement by the Army is scheduled to commence in FY99 and by the Marine Corps in FY00. Initial Operational Capability (IOC) is scheduled for FY00. The MCCM program has been divided into a ground emplacement application (MCCM (GE)) and a vehicle-mounted system application (MCCM (VMS)). Due to the relative maturity of the MCCM (GE) and the balance of time required to complete the development and testing of the MCCM (VMS), each will have separate acquisition milestones but will remain under one funding line.

### PORTABLE VEHICLE IMMOBILIZATION SYSTEM (PVIS)



Originally referred to as "Speed Bump", PVIS is a pre-emplaced capture system designed to stop a 7500 pound vehicle traveling at speeds up to 45 miles per hour without causing permanent injury to the occupants. PVIS deploys in a manner similar to an aircraft arresting gear system. The system also prevents the vehicle's occupants from escaping through the doors. The PVIS will provide security forces the capability to deny approach (in specific lanes or avenues of approach) to a restricted area such as a checkpoint or entryway to a high value

asset/facility. The system will be HMMWV portable and capable of being assembled and emplaced by three persons within two hours. A successful concept demonstration was conducted in FY97 and aggressive acquisition management afforded a favorable MS I/II in FY98, the first of the JNLWP. Following a 12-month Engineering, Manufacturing Development (EMD) phase, MS III is scheduled within the next year. Production will commence in FY00 with an IOC of FY01 and a Fully Operational Capability (FOC) of FY03. Participating services include the Army, Marine Corps, and Air Force.



### NL CROWD DISPERSAL CARTRIDGE (NLCDC)

The NLCDC is intended to fire a non-lethal cartridge for the M203 40mm Grenade Launcher for crowd control. This munition will provide the warfighter with a means to strike a targeted individual with a direct fire, low hazard, and non-shrapnel producing blunt trauma round from 15 to 30 meters. The rubber ball projectiles contained within each cartridge will impact multiple (4-5) individuals closely grouped (10-12 feet) with sufficient force to deter, delay, and/or distract the targeted group of individuals.

Following a successful combined MS I/II in 2nd quarter of FY99; an 18-month EMD phase is scheduled. A greatly desired non-lethal capability, the Army and Marine Corps have indicated intent to procure the NLCDC beginning in FY00. IOC of FY01 and FOC of FY03 are required.

### BOUNDING NL MUNITION (BNLM)



The objective of this program is to field a non-lethal tactical area denial munition for site security and perimeter defense. Intended for employment in a layered manner, multiple payload variants are being developed. 1998 efforts have focused the program on three munitons: blunt trauma (rubber ball), a sting net, and a personal dye marker. It is anticipated that the three variants will produce an audible alert signal to friendly forces within a minimum range of 200 meters. The marking payload will allow for friendly

forces to distinguish transgressors of the defended areas from a minimum distance of 100 meters. Intended to seize trespassing individuals, the net payload will entangle the intruders within a ten to twenty meter area, centered from the munition. 1998 efforts also focused on the technical “form, fit and function” payload compatibility with the components of the M16A2 antipersonnel landmine. The Army and Marine Corps have expressed an intention to procure this system commencing in FY01. A Milestone I decision is anticipated for 2<sup>nd</sup> quarter FY99.

#### CANISTER LAUNCHED AREA DENIAL SYSTEM (CLADS)



Intended to provide friendly forces a rapidly dispensed non-lethal area denial capability, the CLADS launcher will be used to deliver a variety of payloads such as the BNLM. The CLADS project involves downsizing the Volcano Mine Dispenser currently used by the Army. The existing “volcano launcher rack” will be cut to 20 canisters (vice 60-80), and will allow the dispensing of other NL payloads such as riot control agents, NL bounding munitions, and/or marker munitions. 1998 efforts have focused on modification of the volcano launcher rack and development of the mounting hardware for

the HMMWV. An engineering demonstration of the launcher was successfully conducted in 1998. Both the Army and USMC support this program and will be procuring CLADS for their inventories. A Milestone I decision is expected in 2<sup>nd</sup> quarter FY99 and a Milestone II decision in late FY99/early FY00. Milestone III is expected in 4<sup>th</sup> quarter FY00.

#### 66MM NON-LETHAL MUNITIONS



This program is intended to develop and field a short-range, indirect fire, crowd control/area denial NL capability that can be employed from the existing vehicle-mounted 66mm smoke dispensing system (Light Vehicle Obscurant Smoke System [LVOSS]). In 1998, the NL requirements community selected two payloads for this program. The first is a blunt trauma munition with approximately 450 thirty-two caliber rubber balls inside a rubber housing attached to a metal base. The second is a distraction (“flash-bang”) round made of a

polyurethane material. The rubber ball grenades will eject rubber pellets while the distraction device will create an audible and visible distraction. Both rounds are to have the same fixed range of 100-120 meters. The flash-bang round's intended purpose is to distract and possibly deter a crowd from advancing. The rubber ball round is intended to more distinctly influence the targeted crowd's behavior by causing physical discomfort. These munitions will be added to the Army service unique NLW rounds of LVOSS smoke and CS munitions. Production for this program will begin in FY00. Notable for this acquisition program and for the JNLWP were 1998 achievements that included a favorable velocity test result and streamlining the program from five to three years.



## FOAM APPLICATIONS



The focus of the foam program is to develop a capability to temporarily delay access to building openings in MOUT operations and/or temporarily disable selected equipment, vehicles, and weapons. The foam application program will field a new dispensing system (handheld or shoulder-carried) that can be used in a variety of applications involving area denial and countermaterial applications.

An effort is also under way to explore and develop fast-curing “rigid” foams to seal off doors, windows, culverts, or other access points to keep people in or out of certain facilities/areas. For example, the foam will quickly fasten, with strong adhesive and cohesive properties, a door to its jamb to a degree that prevents passage without the aid of tools, explosives, or equipment. The foam could also provide the ability to deactivate counterpersonnel mines or disable weapons. Development efforts continue to focus on efficient packaging and dispensing capabilities as well as on identifying fast acting agents

Slippery foams could potentially deny or delay pedestrian traffic in open areas and could possibly be used to deny access to facilities involving adversaries in a MOUT environment. This foam could also deny or delay vehicles by causing them to lose their traction.

Milestone I for the “rigid” foam is forecasted for 2<sup>nd</sup> quarter FY99, Milestone II is scheduled for 4<sup>th</sup> quarter FY00 and Milestone III is forecasted for 2<sup>nd</sup> quarter FY01. A program baseline is under development for “slippery” foam.

## NON-ACQUISITION PROGRAMS

### VESSEL STOPPER SYSTEM (VSS)



The Vessel Stopper System (VSS), formerly known as the Maritime Vessel Stopper, will provide friendly forces with a non-lethal method of halting suspicious vessels at sea without seriously injuring those onboard. The potential use of the VSS is with the Maritime Preposition Forces, joint Maritime Intercept Operations, and special operations. Its top priority is to stop fast speedboats in order to determine intent. A leveraging opportunity exists with the Coast Guard and counter-drug organizations.

In 1998, a Capstone Requirements Document was drafted due to the large target set, including planing and displacement craft. A draft Operational Requirements Document (ORD) addressing small planing craft was placed in staffing. By FY00 selected technologies are expected to transition into acquisition programs.

As technologies are matched to target sets, more definitive program schedules will be developed and initial fielding will be possible within the near and mid-term. The Navy, Marine Corps, and Army have expressed support for this program; however, it is currently anticipated that only the Navy will include procurement funds in the near term.



#### UAV NL PAYLOAD/DELIVERY SYSTEM



The UAV NL Dispensing System currently has maturing hardware (ALE-47 adaptation) but no delivery platform. The most recent Requirements Integration Group held in 1998 resulted in a determination of no service requirement for this capability from the Pioneer UAV. The USMC was recently assigned as requirements lead, with the FY99 effort focused on re-scoping the program. This program is in a “holding action” awaiting Joint Requirements

Oversight Council clarification of tactical and/or vertical take off and landing (VTOL) platform issues. Possible NL payloads include tear gas, malodorants, pyrotechnics, and caltrops. The Army and the Marine Corps are examining potential VTOL systems to replace the Pioneer that will incorporate NLW dispensing requirements.

#### GROUND (ELECTRIC) VEHICLE STOPPERS

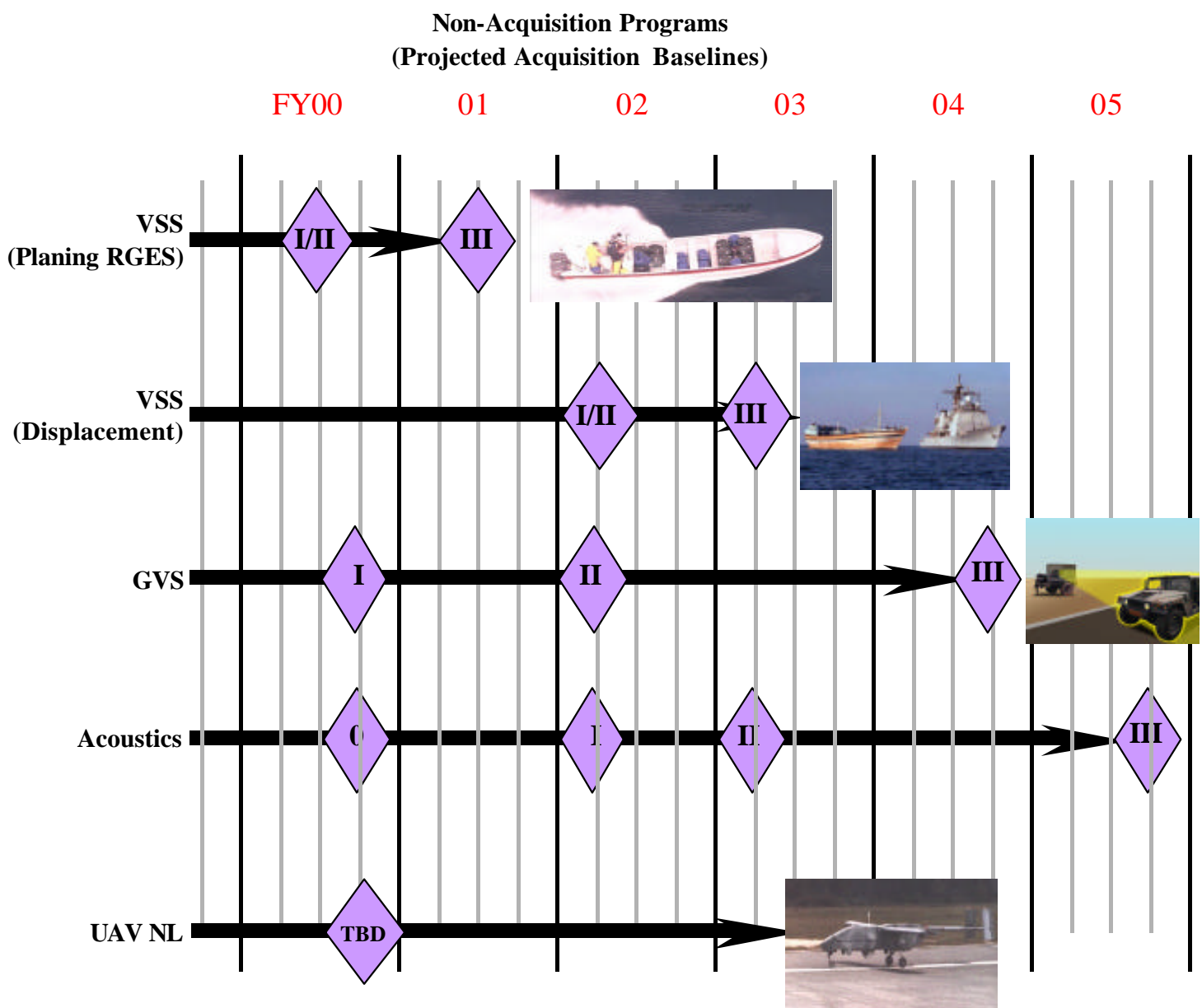


The GVS project will develop and field a new device that will deliver electromagnetic radiation at high power levels from a ground-based microwave source. Personnel will use this system to selectively stop moving vehicles without causing permanent damage to the occupants of the vehicle. The system is currently in the concept exploration phase at the Army Research Laboratory which completed vehicle testing (on the dynamometers) in 1998. A production decision is envisioned for FY03.

## ACOUSTICS

The initial objective of the acoustics program is to demonstrate the biological effects produced from sound energies. Assuming that the ability to project acoustic energy and obtain a useful non-aural target effect from a weaponizable source is shown to be feasible, a positive milestone decision would be expected. During FY98, target effects studies were conducted and a variety of combustion- and electrically-driven acoustic sources were evaluated for potential application. FY99 efforts will culminate with target effects demonstrations scheduled for the 4<sup>th</sup> quarter.

The following diagram illustrates projected milestones for the non-acquisition programs.

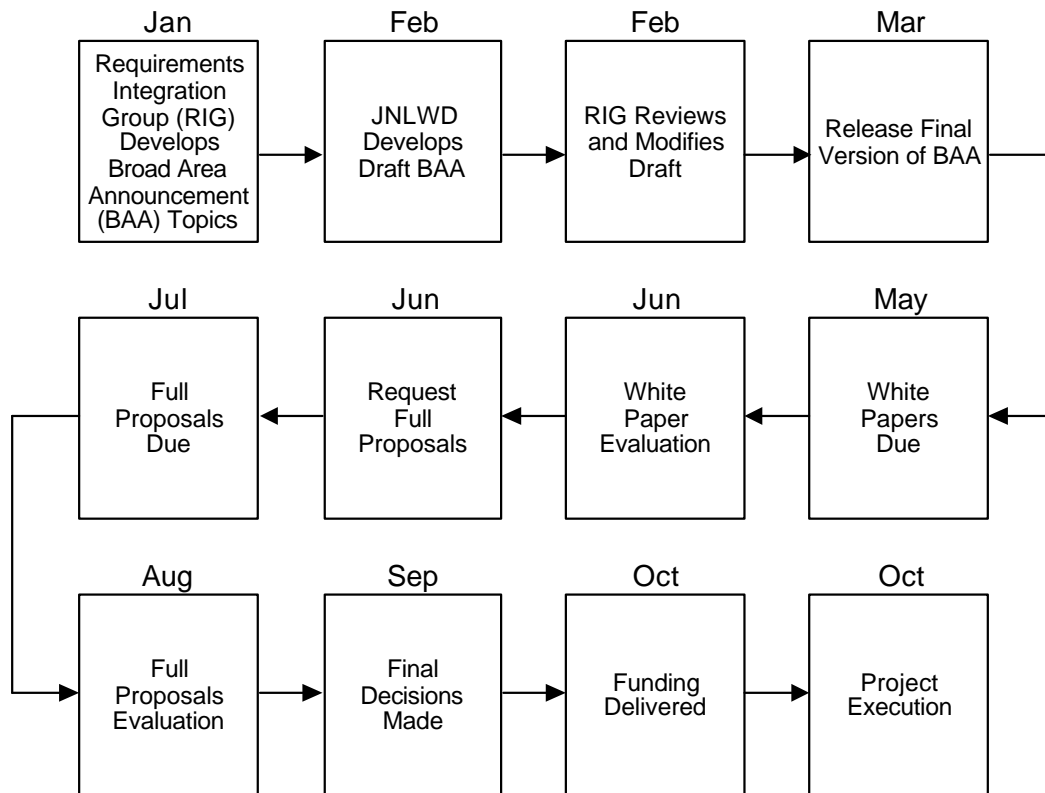




### III. OTHER NLW ACTIVITIES

#### TECHNOLOGY INVESTMENT PROGRAM

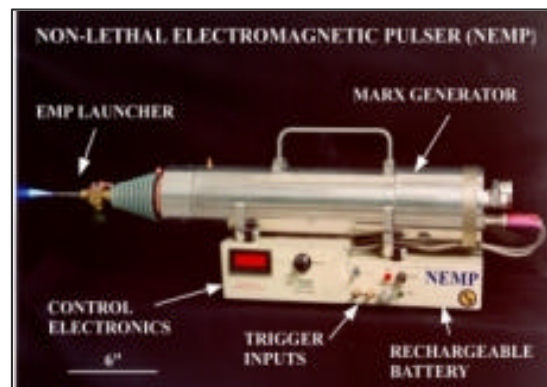
The Technology Investment Program (TIP) was established within the Joint Non-Lethal Weapons Program for the purpose of funding short (1-2 year) initiatives with specific deliverables in supporting gaps identified relative to the core capabilities for NLWs. There is a continuous need within the NLW community for new ideas and technologies to be identified and brought forward. Technology investment is intended to stimulate government laboratories, industry, and academia to generate new technological concepts that expand the utility of NLW in the battlespaces of tomorrow. In 1998, the timeline for the TIP was identified as follows:



The evaluation criteria for the TIP is that the proposal must be worthy of technology investment funding, responsive to the solicitation, technically feasible, have clear objectives and deliverables and it must be able to meet the schedule. Additionally, the proposal must have a reasonable cost. It must demonstrate an acceptable risk to the user and the environment and be countermeasure resistant. The reversibility factor (counter-personnel) or risk to personnel (antimaterial) might be acceptable and the technology proposed should be one of advancing state-of-the-art which can be efficiently supported logistically by the military.

In 1998, three TIPs were funded. These include:

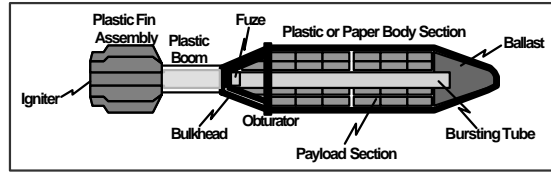
- Odorous Substances - The odorous substances project will develop a comprehensive matrix of distinctive odors related to specific populations, and/or geographic areas. Some odors will be repulsive to the local populace, while others would perhaps be attractive or merely indicate something significant, such as a leak of a flammable material. The matrix or “catalog” will serve to match odors to regions in order to obtain desired target effects. Next, this project will look into locating a chemical compound or mixture of chemicals that duplicates the most important of these odors as nearly as possible.
- Spider Fiber – Spider fiber is a high strength, very elastic, light weight fiber. Spider silk and silkworm silk has been known for centuries for its ability to withstand projectile penetration and for its elastic abilities. Recently, spider silk has been recognized as the strongest natural fiber, up to five times stronger than steel wire for its weight and with 10% elongation. This could be used as an entangling device to disable vehicles, foul propellers, and stop fan blades. There are some significant barriers to this effort, however. Colonies of spiders are impractical for mass production of silk. The genetic structure has proven elusive and attempts to genetically manufacture silk using bacteria have produced only test tube quantities. This effort was completed in FY98, but is a technology to watch for future advancements.
- Non-Lethal Electromagnetic Pulser – The Non-Lethal Electromagnetic Pulser (NEMP) was designed to explore the technology that would disable electronic components in computers and other devices, as well as civilian vehicles. The electronic components of the intended target are disabled by large transient currents generated by exposure to an intense electromagnetic pulse. This is achieved by using a portable, battery-powered Marx generator and EMP antenna/coupling mechanism. NEMP was terminated in FY 98 due to a lack of performance.



In the summer of 1998, the JNLWD received 82 white papers from academic, industry and government organizations in response to a Broad Agency Announcement of April 1998. The 1998 solicitation identified three major topics: tunable non-lethal effects, long range delivery, and non-lethal alternatives to anti-personnel land mines. The proposals selected for funding (FY99 start) included:

- Pulsed Chemical Laser – The objective is to produce non-lethal effects on personnel at a range of hundreds of meters. The effect is the equivalent of delivering a massless, “shrapnel-less” blunt impact on the surface of the target.

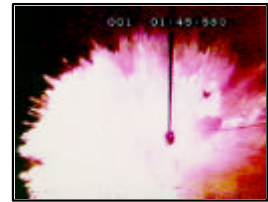
- **Non-Lethal 81mm Mortar** – This proposal is for the use of mortars to deliver non-lethal payloads. The focus of this effort will concentrate on a cartridge for the 81mm mortar system. The cartridge will consist of 1) a means of launch and delivery along with 2) a payload and dispersal system. The desired effect of the payload is to cause disorientation, distraction and/or loss of visual and auditory ability among personnel in the targeted area. To minimize unintended lethal or damaging effects, the delivery/payload package must be fabricated from lightweight, consumable or low impact materials. The anticipated design effort will focus on a projectile that will deliver a long duration acoustic generator producing noise in excess of 130 dB, while dispersing an extremely dense smoke. The smoke passes energy in the infrared range, allowing the warfighter with night vision goggles to effectively see through it.



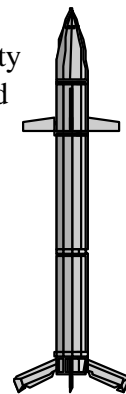
- **Frangible Mortar Casing** – The intent of this effort is to develop a NL mortar round based on the existing M821 120 mm high explosive round. The NLW round flight performance should match as closely as possible the rounds currently in the inventory in aerodynamics, ballistics, firing tables, and propellant loads. Aerodynamic deceleration systems and frangible casings will be incorporated to minimize ground impact velocities to non-lethal levels.



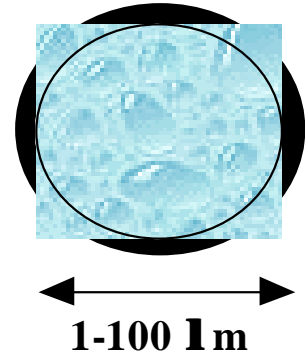
- **Overhead Chemical Agent Dispersal System** – The Overhead Chemical Agent Dispersion System (OCADS) provides a way to rapidly disperse non-lethal chemical agents over large areas. The dispersed agents can be used for crowd control or to provide a remotely generated protective barrier. The OCADS technology is readily adaptable to a wide range of munition sizes ranging from hand-held (i.e., M203 grenade launcher) to mortars. The OCADS will provide a combination of effects to deter an opposing force. The OCADS provides a flash bang effect when the chemical agents are rapidly dispersed. Pepper spray or tear gas could be used to temporarily disable or discourage those threatening. Additionally, visible or ultraviolet "taggants" could be added to the chemical agents to later identify those involved in the confrontation.



- **NLW Guided Projectile** – The objective of this effort is to explore the feasibility of applying guided projectile technologies to provide long-range delivery and deployment of non-lethal weapons. Also, there will be a feasibility study conducted to determine possible uses to include a payload tradeoff analysis and an effectiveness study.



- **Microcapsules** – This proposal for delivery of chemicals by microcapsules will address non-lethal crowd control. This proposal offers significantly improved ways of delivering chemical agents similar to ones already being used, but crudely delivered, such as tear gas. It is an alternative to blunt trauma-type munitions such as rubber bullets. It also makes feasible the use of marker dyes to identify participants. The characteristics of polymeric microcapsules can be used to project a liquid much further, control dispersion in ways not now possible, and prevent redirection by opponents.



- **Airborne Tactical Laser** - This project is for conducting a feasibility study to assess capabilities for an Airborne Tactical Laser (ATL) to conduct non-lethal warfare. The payoff will be in providing stand-off ranges when conducting non-lethal engagements against materiel targets. This effort consists of four basic tasks:



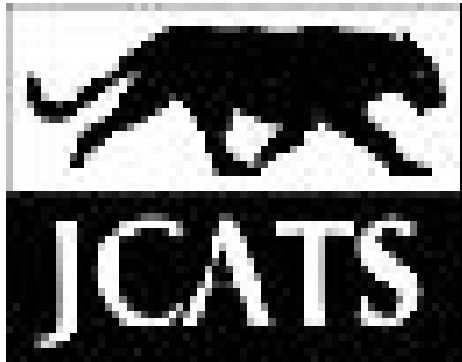
- 1) **Functional Requirements Derivation.** This task will survey the military community to determine the concepts and requirements that relate to an airborne tactical laser for non-lethal applications.
- 2) **System Effectiveness Evaluation.** This task will assess the capability of the ATL to conduct non-lethal missions within a set of defined scenarios and operational environments that were developed within the concepts and requirements community.
- 3) **Development Roadmap.** This task will assess those areas that need to be developed to make an ATL a reality as a non-lethal weapon.
- 4) **Engagement Simulation (Option).** This will be a computer simulation of an ATL being used for a non-lethal mission.

## MODELING AND SIMULATION

The JNLWD has invested and continues to invest significant resources in the development of modeling and simulation (M&S) capabilities for use as tools to assess NLW technologies. Modeling and simulation will provide a capability to train commanders and troops, develop doctrine and tactics, formulate and assess operational plans, conduct mission rehearsal, define operational requirements, and provide operational input to the acquisition process. The intent is also to integrate NLWs into existing DoD models in order to shorten the fielding times of applicable NLW technologies.

Through FY97 and FY98, the JNLW Program has sponsored various modeling and simulation efforts with the goals of initiating an NLW modeling capability, heightening NLW awareness within the greater M&S community, and developing educated buyers on behalf of the joint NLW community. In 1998, the JNLWD continued the effort to analyze the data inputs necessary for model developers to accurately depict NLW usage in applicable scenarios, and to coordinate with service representatives to identify models with joint applicability to NLW training, combat development, requirements development support, acquisition support, and ACTD support.

## JCATS MODELING AND SIMULATION



One of the first M&S programs identified by the Joint NLW community is the Joint Conflict and Tactical Simulation (JCATS). JCATS is an interactive force-on-force simulation used primarily as a combat development tool at the tactical level in support of requirements development, Tactics, Techniques and Procedures development, experimentation support, and concept verification. JCATS is also used to train commanders at the small unit level and to rehearse missions. JCATS will be fully supported through FY04 at which time it may be

replaced by such models as JWARS and JSIMS.

The Joint Warfighting Center (JWFC) oversees all requirements and code modifications to JCATS and works with Lawrence Livermore National Laboratory to implement those changes. Changes to the model are prioritized within a configuration control board (CCB) made up of service representatives that employ the model on a regular basis. JNLW FY98 funding went towards code development to enable modeling of directed energy weapons. This capability, due for release as part of version 1.1.1 in December 1998, will enable effective simulation of beam weapon physics and the battlefield effects from ground and air platforms.

FY99 funding is planned for further enhancements to JCATS as part of version 1.2 release in September 1999. Enhancements include enhanced tracking and targeting, transitioning between lethal and non-lethal systems, and incorporation of additional NLWs systems including effects. Also included is an assessment of crowd behaviors and how they could best be represented in the model.

Current and planned users of JCATS include the Army Intelligence Center, the Marine Corps Warfighting Lab, the USAF Force Protection Battle Lab, TRADOC, NAVSEASYS COM, and others.

### CROWD BEHAVIOR MODELING

Another JNLWD-funded M&S effort involves development of a crowd behavior model that can be integrated with existing modeling and simulation programs. This effort, initiated in FY97, was in response to the absence within any DoD model to account for the presence and/or behavior of noncombatant crowds in the battlespace. Space and Naval Warfare Systems Command (SPAWAR) is working with several contracted organizations to develop such a capability using the MicroSaint behavioral model. The approach in crowd behavior modeling is to conduct basic research on crowd dynamics and incorporate it into a semi-automated forces model. The focus is to determine the effects of lethal and non-lethal force, the effects of crowd density, the influence of nearby actions (i.e., throwing rocks), and resulting casualties.

FY98 funding produced a version 1.0 of MicroSaint capable of modeling crowd behavior within a semi-automated forces environment. This version has been delivered to the Dismounted Battlespace Battle Lab for beta testing. Also included is a written report summarizing the crowd

behavior research conducted. This report is provided to JCATS operators to assist in manual representation of behaviors in the model.

FY 99 efforts call for further research and enhancements for MicroSaint as required by joint users input via the JCATS CCB. Incorporation of MicroSaint into future versions of MODSAF will be pursued pending feedback from beta testing.

## EXPERIMENTATION

The Joint NLW Program in 1998 continued to sponsor NLW experimentation with service battle labs. NLW experimentation applications and priorities are addressed and briefed through semiannual reviews to the JNLWD. Experimentation is accomplished primarily through the U.S. Army's Dismounted Battlespace Battle Lab (DBBL), the Marine Corps Warfighting Lab (MCWL) and the Air Force's Force Protection Battle Lab. These labs focus their efforts on identifying promising new NL technologies and/or operational concepts that may have application in future battlespaces. Promising advanced technologies with potential non-lethal applications will be identified and exploited through the JNLW Program.

1998 experimentation efforts in the MCWL include work on the following:

Non-Lethal Tactical UAV Payloads. The primary effort with unmanned aerial vehicles is to develop an extended stand-off capability. Experimentation with the vertical take off and landing (VTOL) UAV will occur in the MOUT ACTD.



NL Dispensing Unmanned Powered Parafoil. This experimentation is being conducted by the MCWL, NASA, and U.S. Army Engineers. This UAV can be used as an autonomous resupply platform and could possibly be used to dispense liquid non-lethal payloads. It will carry up to 300 pounds in its payload. This effort was completed in 1998 and will not be pursued due to technical difficulties encountered during Limited Objective Experiments (LOEs).

Small Unit Leader's Non-Lethal Trainer (SULNT). SULNT is a training simulation system that can expose a small unit leader to virtual crowds or mobs of up to 1500 people. The goal of the system is to improve the decision-making ability of the small unit leader in the selection and employment of NL capabilities. The successes of SULNT demonstrations in 1998 generated a rapid early fielding to the USMC. Other services are expected to do likewise in 1999.

The Dismounted Battlespace Battle Lab (DBBL) conducted several NLW experiments in FY 98 in support of Joint initiatives with other service battle Labs. Key areas assessed were NLW impact on current TTPs, Vertical Takeoff and Landing (VTOL) Unmanned Aerial Vehicles (UAVs) and under barrel attachments to existing individual weapons. The following LOEs were planned and executed in FY 98:



Cypher UAV LOE (1st QTR): Developed by Sikorsky Aircraft, this platform was designed to carry a 45 pound payload. The unique feature was its oval shape design which made it ideal to



operate in an urban environment. Incorporating the Navy chaff system (ALE 47) as the primary dispensing system, DBBL evaluated a myriad of non-lethal payloads for accuracy, ease of use, and soldier interface. The experiment was a success due to the simplicity of the system for soldiers to operate and the ability to navigate between buildings. The major draw back was platform size and the logistic profile required to maintain continuous operations.

Camcopter UAV LOE (1st QTR): Developed by Schiebel Industries, this platform proved to be an exceptional platform for dispensing non-lethal payloads (i.e., caltrops, smoke grenades, smoke pots). Incorporating the Navy Chaff system (ALE 47) as the primary dispensing system, the Camcopter obtained the same accuracy as the Cypher; however the platform's hardware configuration and flight control module was better than the Cypher. In addition the design was much smaller with the same payload capacity as the Cypher. The only weakness was operating in a restricted urban environment where the likelihood of making contact with a structure would cause a catastrophic failure.

Under Barrel Tactical Payload System (LOEs). The purpose of a series of experiments were to evaluate the utility of taking Commercial Off The Shelf (COTS) paintball technology for tactical use as a NLW. The system was designed for attachment to the M16A2 and M4. The end Measure of Performance (MOP) was to attain a capability to accurately engage targets out 100 meters. Initial experiments proved to be disappointing due to the circular paintball munitions design. Round balls historically have been inaccurate and our earlier experiments did not disprove that theory. The vendor (Monterey Bay Corp) reengineered the paintballs with a fin stabilized feature and optimized weight variables. Follow on LOEs demonstrated that the redesign proved to 80 percent more accurate against E-Silhouette targets out to 100 meters.

Tactics, Techniques, & Procedures LOEs: The objective of the LOEs were to assess the impact of NLW on current infantry TTPs across the spectrum of operation with particular interest on Military Operations Other Than War (MOOTW). The LOEs provided a considerable amount of performance data on NLW mixes, and insights on changing TTPs that historically have been focused on combat operations. The accumulated data will be inserted into modeling and simulation wargaming models to refine and build draft TTPs and Mission Training Plans (MTPs) for infantry from platoon to squad level.

Non-Lethal Tactical UGV Payloads. Unmanned ground vehicles offer promise for demonstrating a non-lethal capability. For example, 66mm NL munitions will be mounted on a UGV as a delivery device for CS, stingball grenades, and/or flash bang grenades to a range of 100m. Non-lethal dispensing systems on UGVs will be experimented with using pepper spray or a water stream. UGVs create a high volume launching platform that could carry NL payloads, allowing the warfighter to focus on augmenting the target effects of the UGV or re-directing to other targets.

In the near term, one Advanced Concept Technology Demonstration (ACTD), Military Operations in Urban Terrain (MOUT), has specific non-lethal weapons applications. This ACTD is being co-sponsored by the Army and Marine Corps. The JNLWD, with DBBL as its authorized agent, will act as the executor for the planning and integration of non-lethal weapons into the MOUT ACTD experiments. In addition, the DBBL, as the JNLWD's authorized agent,

will develop small unit Mission Training Plans and Tactics, Techniques and Procedures to be used as the basis for non-lethal weapons integration into MOUT experiments. The DBBL will also provide the necessary non-lethal items for applicable Army and Marine Corps participating units.

Additionally, *Urban Warrior*, as a phase of the MCWL's Sea Dragon Five Year Experimentation Plan (FYEP), will continue to conduct experiments to seek solutions to such challenging areas as fires and targeting, mobility and maneuver, sea-basing, and close combat in cities. Results of all experimentation continue to be evaluated for their warfighting enhancement potential by the joint NL community through the Concept Based Requirements System (CBRS).

## OTHER JOINT NLW EFFORTS

### THE JOINT NLW MASTER PLAN



The Joint NLW Master Plan provides program overview, background information, and guidance for the execution of the DoD Joint Non-Lethal Weapons Program. It also serves as a research and development strategy for the program. This capstone document was drafted in 1998 and in the future it will be published no less than every two years.

### WEB SITE

The JNLW Directorate maintains a web site accessible through the Headquarters Marine Corps Home Page. The web site is used to keep the joint non-lethal community informed about upcoming events, reviews and briefings, program status, and background information. The address is:  
<http://www.usmc.mil/nlw>





## HUMAN EFFECTS ADVISORY PANEL (HEAP)

The successful use of non-lethal weapons is grounded in the user's level of confidence that the consequences of their employment will decrease rather than increase the level of confrontation. To achieve this level of confidence, the human effects of these non-lethal weapons must be completely understood. Commanders in the field, when faced with the decision of which non-lethal weapon to employ in a given scenario, must be able to accurately predict the most probable effects on people. There is a recognized need for an expanded understanding of non-lethal weapons that must include a method to accurately assess the human effects of non-lethal weapons and to present those findings in a consistent, easily understood manner.

The JNLWD has contracted with the Applied Research Laboratory at Pennsylvania State University to establish the Human Effects Advisory Panel (HEAP). Panel members were chosen from the medical research and academic fields, and they are recognized experts from applicable technical fields. In 1998, the HEAP undertook the following tasking to:

- Provide a definition of non-lethal weapons that includes a quantitative metric of a specific weapon's effectiveness against a general population;
- Assess methodologies to measure the human effects of blunt impact munitions non-lethal weapons and provide a recommended method.
- Review existing blunt impact munitions data and determine if sufficient information exists to create employment guides for use by an on-scene operational commander that include the expectations and consequences of the use of a specific non-lethal weapon.

Results of these HEAP efforts will be available in the 2<sup>nd</sup> quarter of FY99.

## NATIONAL POLICY STUDY

In 1998, the Office of the Secretary of Defense requested that DoD lead an interagency study to address the U.S. policy for NLWs. Non-lethal weapons, when viewed from a strategic perspective, raise numerous policy issues that must be thoroughly explored. The Center for Strategic and International Studies is supporting this study and engaging notable personalities to determine if there is a need for a national policy and, if so, what the guiding principles are.

The objective of this study is to examine the need for a national-level policy for non-lethal weapons and, if needed, to outline that policy. The study will emphasize possible long-range, large-scale non-lethal weapons. The political, military, diplomatic, arms control, legal, psychological, and intelligence dimensions of NLWs will also be explored. If a need or a use is identified for such non-lethal weapons, the study would outline elements of a national policy for consideration by a DoD Steering Group.

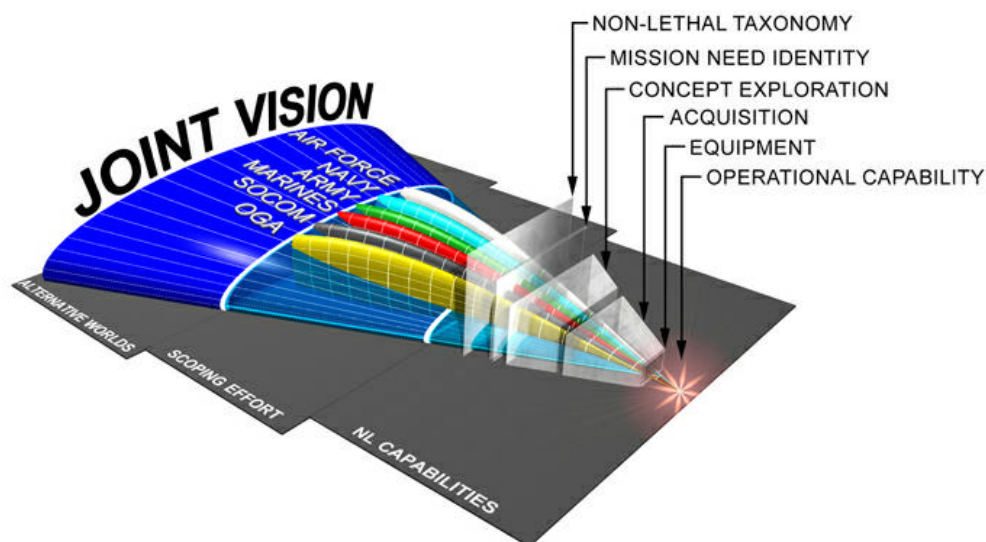
The study will analyze in depth the following issues, at a minimum:

- Political and diplomatic needs for additional military options that could be enabled by the employment of long range, large-scale non-lethal weapons. This analysis will include substantive interaction with the Department of State to assess fully the means by which such systems could support American diplomacy and any secondary international political effects of fielding or employing them.
- The types of future situations in which these systems could provide the United States with significant political-military advantages.
- The ramifications of fielding and employing such weapons, in terms of arms control, international law, and public acceptance, as well as public support for military action.
- Possible contributions to deterrence of aggression, achieved through a combination of declaratory policy and the visible possession of such capabilities.
- Types of weapons and general concepts of operations, their technical and operational feasibility, and their (roughly) estimated costs, as well as their affordability within the context of a balanced defense program.
- The specific needs for a national-level policy, as distinct from the existing Department of Defense policy, and, if needed, the nature of such a policy. A strawman policy may be generated if appropriate.

These issues will be addressed through such techniques as substantive analysis, evaluation of the potential contributions of strategic non-lethal weapons in past conflicts and projected future conflicts, games, seminars, and other devices. In addition, the advice of very senior former government officials will be obtained.

### VISION PROJECT

In 1998, the JNLWD initiated the work on determining the non-lethal capabilities and applications that may be needed in the distant future. The first step in the Joint NLW Vision



**JNLW Vision**

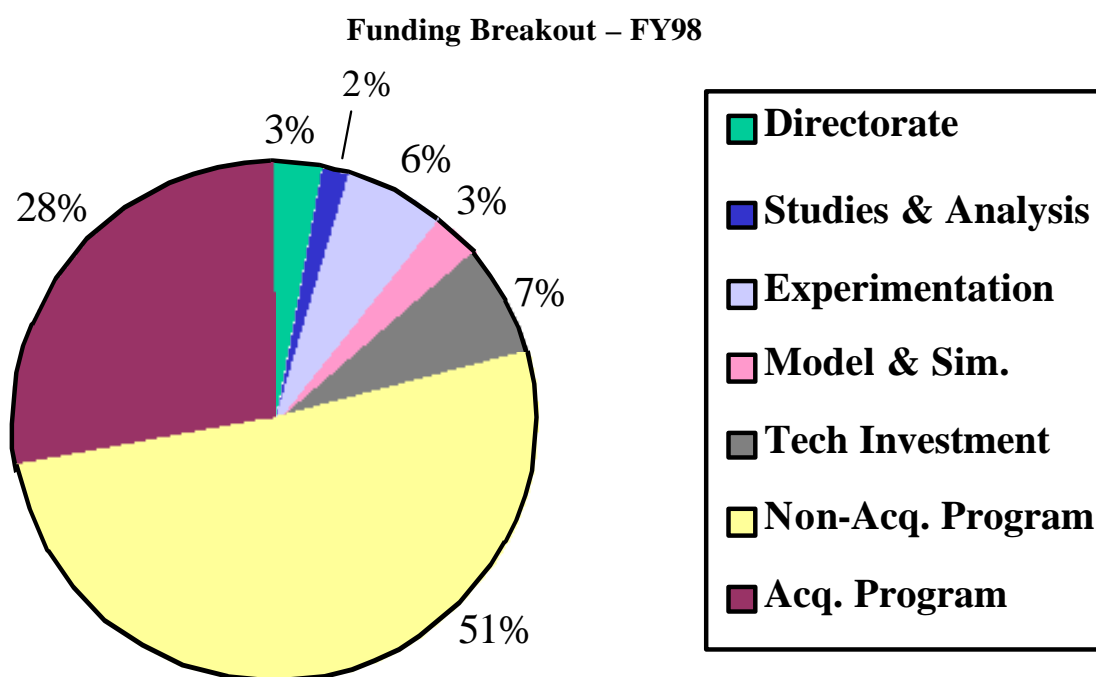
Study for the Year 20XX was initiated by the JNLWD and supported by the Marine Corps. The USMC Deputy Chief of Staff for Plans, Policies, and Operations asked the Center for Naval Analyses (CNA) in mid 1998 to conduct a quick response study to determine the future environments in which NLWs might be employed, and to identify the NLW capabilities needed in those environments.

The CNA's resulting summary report, entitled *U.S. Marine Corps and NL in the 21<sup>st</sup> Century*, together with two supporting annexes, provides a framework for further research and analysis of the role of NLWs in both service and joint strategy, operations, and tactics. It addresses the two tasks identified in the initial request: developing potential future operating environments and identifying desired non-lethal capabilities for these environments. This vision laid out by the report identifies various scenarios under which the USMC may be operating over the next 25 years and how NLWs might apply within those scenarios. It takes a comprehensive view, looking at global and regional trends across a wide spectrum of human activity and identifying those characteristics most relevant to the use or non-use of NLWs.

The results of this quick response report are preliminary. Follow-on analyses will be conducted in FY99 to provide a joint focus and to address variations in NLW use on differing terrain; analyze the actual and potential applicability of NLWs to recent operations; and update and explore in more detail the findings of this report.

#### IV. FUNDING

As a ramp-up year, FY98 funding of \$16.8M was distributed as shown below. The Joint Non-Lethal Weapons Program received a substantial boost in the Fiscal Year 99 Defense Budget, with \$12 million added to the program's \$22.6 million request for FY99. The additional funding will expand human effects studies, accelerate the acquisition cycle of several existing programs, and fund new technology initiatives, including a dedicated tactical area denial system concept exploration program.



## V. SUPPORTING EFFORTS

### NIJ AND JNLWD COOPERATION

Lieutenant General Steele and Dr. Jeremy Travis, Director of the National Institute of Justice (NIJ), the research arm of the Department of Justice, signed a Memorandum of Agreement in November 1998 which formalizes the relationship between these institutions in cooperative R&D for dual-use NLW technology. This "joint" effort is an excellent model of interagency cooperation with associated mutual benefits.



### JOINT NLW TRAINING



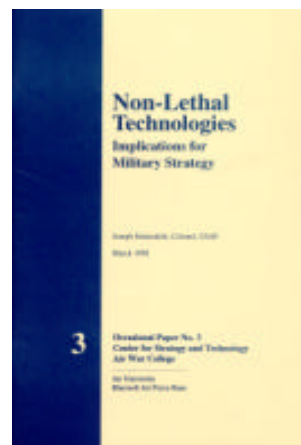
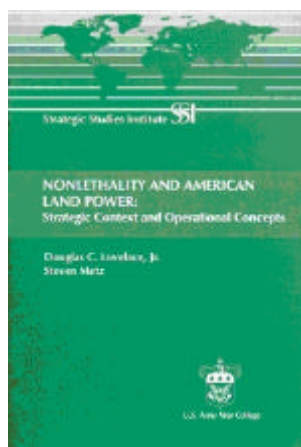
Significant progress occurred in 1998 toward establishing a joint "train-the-trainer" course for NL techniques. An approved two-week, Marine-only course is currently being conducted four times a year at the US Army MP School at Ft. McClellan. The MP School has also been responding regularly to requests for Mobile Training Teams (MTT) around the world. The resident course will assist in reducing MTT requirements. The Training and Education Division at the Marine Corps' Combat Development Command in Quantico,

Virginia, in conjunction with the JNLWD, is sponsoring, through the Inter-Service Training Review Oversight committee, an effort to integrate the Marine course into a joint course. The location of this course is yet to be determined. It is anticipated the first joint course will be conducted at the beginning of the new fiscal year (00).

### WAR COLLEGE RESEARCH PROJECTS

During the year, the JNLWD has contacted the service War Colleges to solicit their ideas and to identify research topics relating to the future of non-lethal weapons from a tactical as well as strategic perspective. Research projects relating to the future of non-lethal weapons are currently being conducted by students at several institutions. Selected works will be posted on the JNLWD web site. A number of NL research papers were published this year. In response to the Chief of Staff of the Army, Professors Lovelace and Metz at the Army War College's Strategic Studies Institute conducted a research and analysis effort. Included in their work are specific recommendations and cautions concerning the application of non-lethal technologies.

Colonel Siniscalchi from the Air War College in his research paper conducts an assessment of non-lethal technologies of today and how they are positioned for emerging strategies and missions.



## VI. CONCLUSION

The JNLWP is completing just its second full year of operation in 1998. There has been a great deal of progress this past year, particularly in organizational issues and in advancing technologies rapidly towards realizing new military capabilities.

Last year's annual report outlined objectives for the NLW community for 1998. Among them were:

- *Improving the capability and readiness for the deployed forces.*

NLWs were a part of the deployed forces capabilities sets in Haiti and Bosnia. The NLWs are a contingency option for the warfighters today, with equipment in place and ready to go. This progress is significant in light of the environment our warfighters are working in.

- *Identifying the increased participation of supporting services in individual projects and eliminating duplication of effort.*

Today there are organizations identified in the NLW community with regular participation from all services and SOCOM. This continuity has led to a focused and coordinated effort resulting in a streamlined and more timely fielding process for NLWs.

- *Compressing the fielding timelines by 1/3 of all the acquisition projects.*

Although this goal was not uniformly met, there is now considerable effort by NLW program managers, acquisition and budget analysts, and industry representatives to work together in modifying and possibly compressing program timelines. The PVIS and 66mm non-lethal munition program are examples of this effort.

- *Exploring new concepts for technologies and employment.*

The TIP process has energized industry and government laboratories in pursuing NLW possibilities. The submission of 82 ideas for the TIP to consider this year is an

example of the continuous effort needed within the NLW community for new ideas and technologies to address the challenges of the future.

- *Raising awareness and education in the operating forces.*

A NLW “train the trainer” course has been initiated this year. Mobile training teams focusing on NLWs have assisted in educating the operating forces on a number of occasions this year. All of the Theater CINCs have received detailed JNLWP briefings in 1998. Finally, there have been a number of research efforts at a variety of academic institutions conducted this year examining the future of NLWs. This will continue to play a role in raising the awareness level to the operating forces and the public for the future employment of NLWs

The effort is well worth the time, energy and resources because non-lethal capabilities, particularly in the ever-increasingly chaotic and violent world of peace operations, can potentially play a decisive role. Non-lethal technologies represent significant advantages across the spectrum of conflict by encouraging peaceful solutions, creating flexibility for the operational commanders and potentially adding strategic options at the national command authority level.

The evolution of the technologies will play a large role in the maturing of the JNLWP. While the tactical application of non-lethal weapons is well understood, the technologies of the future will need further analysis and community involvement. Many of the non-lethal capabilities designed for future use have only been demonstrated in laboratories and their full potential must be expanded and weaponized to create longer ranges and with greater non-lethal impacts on the identified target sets. This will be realized by precision effects and selective engagement. This expansion of capabilities will continue - the future is promising.

1998 was indeed a year of progress. There have been significant organizational changes in an effort to streamline the process in providing non-lethal capabilities to the warfighter. The Memorandum of Agreement has undergone several revisions with significant progress made, the education and awareness relative to the employment and applicability of non-lethal weapons has risen dramatically, and perhaps most important, the acquisition programs are well on their way to adding to the warfighters options.

With this in mind, now is the time for a focused effort, hard work and coordination in developing and improving non-lethal technologies. Competing funding priorities as well as demands on units and scarce resources all impact the future of non-lethal weapons. 1998 has been a Year of Progress - it is up to the entire non-lethal community to continue the effort.